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Biodiversity knowledge elements in Biology education: the base of critical thinking

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Abstract

While people need to have significantly growing scientific knowledge about plants, there has been a decrease in student education about and interest in botany over the same period. According to the state of the world plant 2017 report from 2016, 1730 plant species are new to science and one from five plant species is endangered with extinction (See the State of the World's Plants Reports, Kew). Considering these facts, it is clear that the botanical knowledge in dynamic learning and teaching topics as well as the critical review of the knowledge elements are very important for the young generation. Within environmental education the elements in school materials (textbooks, experimental textbooks) are examined, which develops plant recognition skills and local or global botanical knowledge. In this article the results of a content analysis are summarized, which extends to the exploration of plant species in the currently most frequently used textbooks, in the 7th, 8th, 10th, 11thor in the 12th Hungarian primary and secondary school classes. This work also demonstrates the value of the plant species appeared in these applied textbooks, and even the rate of the categorized elements most importantly the protected species. Earlier works: The history of methods teaching Biology from the early childhood, The emergence of biodiversity concepts or concept related elements in the Hungarian Biology curricula.

*Keywords:*plant species; textbooks; Biology education

1. Introduction

Nowadays people are facing a drastically changing environment and a variable biotic factor on Earth: biodiversity. The spread of invasive alien species (Weber, 2017) and the rapid decrease of the spread of invasive alien species and the rapid decrease of the number of known living plant species continuing to be one of the major threats to habitats and their species diversity. (Cooper, 2008) Invasive alien species are actually non-native species, brought into new regions by human activities, and exhibiting negative impact on natural habitats and their communities due to their population growth. Such species are found in all groups of life forms e.g. plants (Link-Perez et al., 2018). The major causes for the establishment of species outside their natural ranges are the

increasing trade volume around the planet, the continuing habitat destruction and the pollution. Invasive plant species can have various impacts on the invaded plant or even on the animal communities. The losers are not only native plant species but may also include insect species dependent on these and bird species dependent on the insects. Thus, invasive alien plants may affect all trophic levels in an ecological community. (Weber, 2017)

In order to have this interpreted by the rising generation, educators need to teach them obviously which plant species are native, invasive or other in their natural habitat, the examples of which need to be discovered. (Drea, 2011)

This paper provides details about all the plant species that currently occur in the most frequently used textbooks from grade 7^{th} to 12^{th} together with the list of their information.

2. The applied methods

This work aimed to list the plant species that appeared at least once in the most commonly used experimental Biology textbooks published by the OFI (Hungarian Institute for Innovation in Education) from primary 7^{th} classes to the 12^{th} secondary school classes. Reading through each text content of each book word by word the emerging plant names are listed, indicating its value and also that the given species belongs to the native(n), invasive(i) or cultivar(c) category. After each table, a diagram signifies the rate of the appearing plant types.

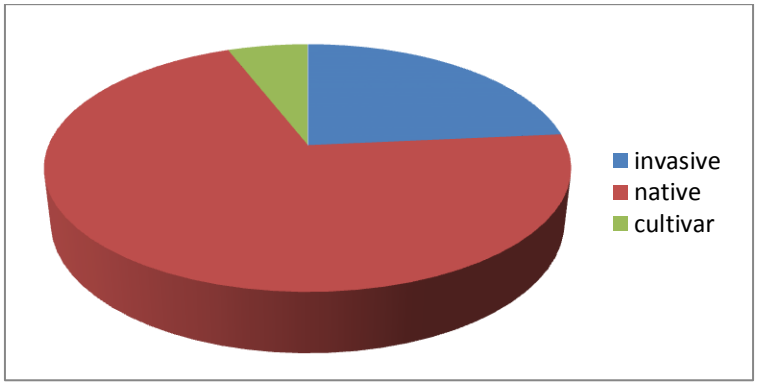
2.1 Species occurance in the New generation textbook (class 7) published in Kropog& Németh (2018)

Table 1. Species occurance in the New generation textbook (class 7)

Species Latin/English	**Native/invasive /cultivar n/i /c**	**Value**
Nepenthes/ Pitcher plants	i	insect consumer
Corydalis cava/ Coridalis flowers	n	distributed by ants
Allium ursinum/ Wild garlic	n	edible
Rosa canina/ Rosehip	n	wild medicinal plant
Crataegus sp/ Haw	n	wild medicinal plant
Quercus cerris/ Turkey oak		forest element
Stipa sp./ Porcupine grass	n	**protected**
Echinops ritro subsp. ruthenicus/ Echinops	n	insect attraction
Alkanna tinctorial/ Alcanet	n	salt indicator
Matricaria chamomilla/ German chamomille	n	medicinal plant

Robinia pseudoacacia/ Acacia robinia	i	bee food, invasive species
Triticuma estivum L./ Common wheat	c	cultivated food plant
Calamagrosti sepigeios/ Rostite	n	invasive
Ambrosia artemisiifolia/ Ambrosia	i	invasive
Convolvulus arvensis/ Convolvulus		weed
Cichorium intybus/ Chicory		medicinal plant
Arctium lappa/ Greater burdock	n	big weed
Plantago major / Fleawort	n	medicinal plant
Ailanthus altissima / Tree of heaven	i	invasive
Carpinus betulus / hornbeam	n	forest element
Fragaria vesca / Fragaria	n	wild edible plant

Table 1.1 Species occurance in the New generation textbook - diagram (class 7)



There are 17 plant species mentioned in the 7th class experimented textbooks out of which there is only 1 protected. 13 species are native in the list, 4 invasive while 1 represents the cultivar category.

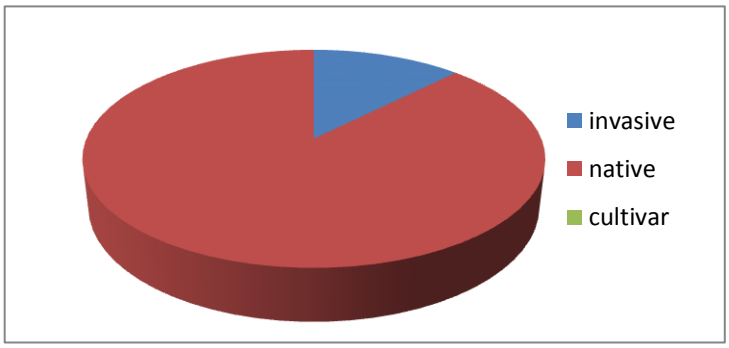
2.2 Species occurance in the New generation textbook (class 8) published in Kropog& Németh (2018)

Table 2. Species occurance in the New generation textbook (class 8)

Species Latin/English	**Native/invasive sp. (n/i)**	**Value**
Gingko biloba / Kew tree	i	Taxonomical example
Malus domestica / apple	n	cultivated
Orchis purpurea / Lady orchid	n	**protected**

Trollius europaeus /Globe flower	n	ice age relict, **protected**
Osmunda regalis / Royal fern	n	**protected**
Sphagnum sp. / Peat moss	n	**protected**
Lemna sp / Common duckweed	n	-
Quercus petrea / Sessile oak	n	Forest element

Table 2.1 Species occurance in the New generation textbook – diagram (class 8)



There are 8 plant species mentioned in the 8th class experimented textbooks out of which there are 4 protected. All the mentioned plant species are native except for one, which is invasive and cultivar category is not represented.

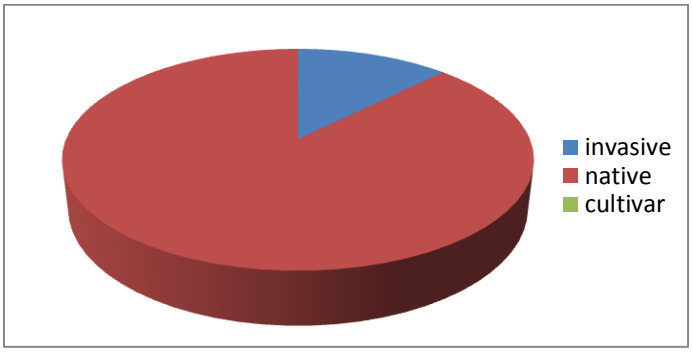
2.3 Species occurance in the New generation textbook (class 10) published in Mándics&Molnár (2017)

Table 3. Species occurance in the New generation textbook (class 10)

Species Latin/English	**Native/invsive sp. (n/i)**	**Value**
Mycrasterias sp. / Green algae	i	Taxonomical example
Polytrichum formosum / Wood-moss	n	taxonomical example
Marchantia polymorpha / Liverwort	n	
Pulsatilla grandis / Greater pasque flower	n	**protected**
Sempervivum marmoreum / Common houseleek	n	special adaptation
Lycopodium annotinum / Clubmoss	n	**protected**
Dryopterisfilix-mas / Fern	n	**protected**
Equisetum arvense / Common horsetail	n	taxonomical example
Dicksonia antarctica / Fern tree	i	**protected**
Taxus baccata / Yew-tree	n	toxic
Ginkgo biloba / Kew-tree	i	iceage relict
Lilum martagon / Martagon-lilly	n	**protected**
Rubusidaeus / Raspberry	n	edible wild

Acer pseudoplatanus / sycamore-maple	no data	forest element and cultivated
Fagus silvestris / Common beech	n	forest element
Solanum sp. / Nightshade	i	toxic or cultivated
Yucca / Yukka	i	cultivated

Table 3.1 Species occurance in the New generation textbook – diagram (class 10)



17 plant species appear even in the 10th class experimented textbooks out of which there are 5 protected. 11 species are native in the list, 5 invasive while none of them represents the cultivar category.

2.4 Species occurance in the New generation textbook (class 11) published in Mándics&Molnár (2017)

Table 4. Species occurance in the New generation textbook (class 11)

Species Latin/English	**Native/invasive sp. (n/i)**	**Value**
Daucuscarota subsp. sativus / Carrot		Cultivated
Cucurbita pepo / Courgette		Cultivated
Prunus armeniaca / Apricot		Cultivated
Citrus sinensis / Orange		Cultivated
Allium cepa / Red onion		Cultivated
Solanum tuberosum / White potato		Cultivated
Solanum lycopersicum / Tomato		Cultivated
Brassica oleracea var. capitata f. rubra / Red Cabbage		Cultivated
Triticum / Bread wheat		Cultivated
Capsicum annuum / Cherry pepper		Cultivated
Papaver rhoeas / Oil - poppy		Cultivated
Glycine max / Soy		Cultivated
Allium ursinum / Bear leek		Cultivated
Brassica oleracea var. capitate /		Cultivated

Turnip	
Phaseolus vulgaris / Chard	Cultivated
Pisum sativum / Green pea	Cultivated
Cucumis sativus / Cucumber	Cultivated
Lactuca sativa / Lettuce	Cultivated

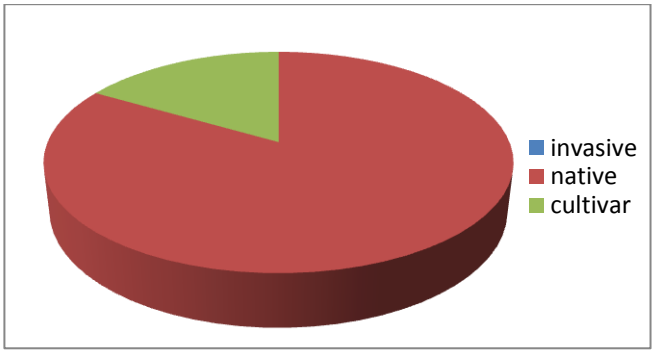
18 plant species are referred in the 11th class experimented textbooks and all of them are cultivated while none of them represents the native or the invasive category.

2.5 Species occurance in the New generation textbook (class 12) published in Mándics&Molnár (2017)

Table 5. Species occurance in the New generation textbook (class 12)

Species	**Native/indigenous sp. (n/i)**	**Value**
Antirrhinum majus / Snapdragon	n	Cultivated
Pisum sativum / Green pea		Cultivated
Dryopteri scristata / Crested wood fern	n	**protected**
Ferula sadleriana / Spear	n	Glacial relict, **Protected**
Aconitum moldavicum / Monkshood	n	**Protected**
Stipa capillata / Feather grass	n	**Protected**

Table 5.1 Species occurance in the New generation textbook - diagram (class 12)



In the 12th class merely 6 species names could be listed. 4 of the elements are protected, 1 is a glacial relict and 2 are cultivated.

3. Results

Biological invasions are widely acknowledged as a major threat to global biodiversity. Considering that there are not much documented examples of either native, invasive or cultivated plants species and that many plants are poorly studied (Thomas, 2017) in this paper, the number, the value and the appearance rate of the mentioned species taught today in one textbook series are accurately signified.

According to the diagrams and the collected data it maybe asserted that Biology books applied in primary or even in secondary schools contain relatively a few representative plant species.

Although it is taught that in the 10^{th} class, there are 1,8 million species (Mora, 2011) in class 7, only 21 plant species, in class 8 only 8, in class 10 merely 17, in class 11 only 18 species appear and in class 12 only 6 representatives of plants are mentioned in the textbooks. It is surprising because in class 10 students comprehensively learn the most about plants, classes or subclasses, the structure of the plants or even the photosynthesis process. Perhaps, it would be more significant to show them the best examples of the plant categories to make it easier to interpret at that age.

Nature conservation is taught in class 12^{th}, without having no clear example of what creatures need to be protected on Earth.

There are only a few protected plants species in the experimented textbooks. In class 7 there is only 1. In class 8 the number of protected plants is 4., in class 10 there are 5, while in class 11 there are no protected species at all. In class 12 there are again only 4 emphasized representatives.

It would be equally important to young people to get to know more about those species that are marked in the learning material or what surround them in the reality but the texts in general simply mention a plant and very often there is no other reference to it (pictures, illustrations, data or practices that brings it closer to the learners).

The other problem is that if the facts are far from reality sooner or later it makes the students uninterested. There are no references where the actual events or state of species would have mentioned about the plants.

School books used nowadays should even be close to the digital world being full of references to each and every plant species. Without it, teachers could not involve the students in the tasks. and they could not digest the actual material easily. There are no references to it at all.

Another perspective is that students must be taught out of school for species because indeed there are only some native and protected species in their textbooks. They also get additional information about the commercial use or conservation state of the species. A great variability of

projects could be run of which the main subjects are taxonomy, plant conservation, plant physiology, horticulture and methods of teaching Biology and environmental education (Pénzesné, 2017) using the garden plant databases or seedbanks. The diverse collection of plant forms would attract the younger generation, too.

These plant species are mentioned in the textbooks but what about the rest of the species information? The distribution, or if they are invasive or alien species, the labeling of the native or indigenous ones or their natural habitat. Evaluating the rate of these characteristic features can also be significant (e.g. how many species are there in medicinal plant categories). This is what diagrams serve as an indication, but it is clear that most of the time the relevant information is missing. How can a young child learn about creatures in the classrooms if he or she doesn't have an example in front of them? How can we expect them to identify and save them in the nature? We teachers would have more opportunities if newer methods or smarter material such as some good practices of teaching materials about the MÉTA program could be integrated in the textbooks.

Analyzing more source of information (curricula, exercise books such as Mozaweb series) or by presenting some concrete idea to improve the practical work of teachers regarding teaching plant species would be urgent and eligible.

4. Conclusions

Species are fundamental building blocks of nature and ecology. Without the continued survival of many of their number, the goals of ecosystem and biosphere management are unattainable. Species are also fundamental units of the evolutionary process, and their increasing loss due to the anthropogenic causes represents an irreversible depletion of genetic material upon which evolutionary potential can work in future. Hence, extinctions arising from man's influence are the events that the conservation movement aims to prevent. (Entwistle 2000)

The real conservation of our nature starts with the acquired up-to-date knowledge that is used by the upcoming generation when a species appear. In schools when textbooks are applied students need to find updated information about the world surrounds them in order to provide sustainability effectively. To achieve this it is worth quantifying species content of the current Biology curricula. Whenever a species is mentioned on the pages it is needed to examine whether the value, the habitat or even illustrations about the species are labelled or not. Even if species diversity loss is one of the most threathening factor to human nature, some textbooks species content is not much.

As far as the plant species richness is concerned this current work contains information obtained from one of the most wildly used textbook series edited by the OFI. From classes 7 to 12 these books contain examples of plant species however very often the real purpose of the presence of them are not necessarily up-to-date and lifelike. The number of the indicated examples are also worthy of consideration as well as the illustrations and description of them.

The education of plant diversity should focus on more the habitat, the appearance or the practical application. Is it really the best direction towards the sustainable future?

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Short professional biography

Éva Nagy: Currently She is teaching English-Biology and Self-study in Eger in the Neumann János Secondary Grammar School. At first, she graduated at the Eszterházy Károly University in Eger (English and Biology and later Master of Biology) and a few years later at the University of Debrecen (English). Now she is a Ph.D. student at the Faculty of Educational Sciences at Eszterházy Károly University. Her field of research focuses on examining the role of species diversity in environmental education and awareness-raising.